

MEDB 5.2 On-Orbit Strength & Conditioning Monitoring

3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MEDB# and Title:	MEDB 5.2 On-Orbit Strength & Conditioning Monitoring
Sponsor:	Medical Operations
Discipline:	Bone, Muscle and Exercise
Category:	Medical Requirements
References:	SSP 50260 ISS Medical Operations Requirements Document (MORD) SSP 50667 Medical Evaluations Document (MED) Volume B
Purpose/Objectives:	To fulfill the medical requirement that all crewmembers shall participate in a program of prescribed and scheduled exercise during flight. The exercise prescription shall be recorded and adherence to the prescription will be evaluated. This information will be used to assess crew health, countermeasure effectiveness, and provide a historical record of the exercise program performed during flight.
Measurement Parameters:	The following information will be collected: <ul style="list-style-type: none">• For All Exercise Modalities: Number of training sessions/week.• For Treadmill 2 (T2): Speed, subject loading, heart rate, exercise duration and tread resistance (passive mode only); ground reaction forces• For Cycle Ergometer with Vibration Isolation and Stabilization (CEVIS): Work rate (Watts), pedaling speed, heart rate, exercise duration, and arm cycle session• For Advanced Resistive Exercise Device (ARED): Exercises performed, prescribed load, dialed in load, number of sets number of and repetitions, and ground reaction force (GRF) data.
Deliverables:	<ul style="list-style-type: none">• Exercise prescriptions for each crewmember, updated as the mission progresses.• Reports to the surgeon regarding the exercise activities conducted during flight for each crewmember will be delivered every other week. A final summary report detailing all exercise conducted during flight and outcome measures from ground testing.
Flight Duration:	≥30 days
Number of Flights:	Every Expedition
Number and Type of Crew Members Required:	All ISS crewmembers.
Other Flight Characteristics:	N/A

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3.3 Preflight Training:

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity	Description:	<p><u>CMS ARED Operations (for all crew):</u> This lesson introduces the student to the purpose, components, and operations pertaining to the Advanced Resistive Exercise Device.</p> <p><u>CMS CEVIS Operations (for all crew):</u> This lesson introduces the Cycle Ergometer with Vibration Isolation System (CEVIS) and Heart Rate Monitor (HRM).</p> <p><u>ARED Physical Training sessions (for all crew):</u> This training builds the knowledge base and enhances the physical skills required for crew to effectively and safely operate Advanced Resistive Exercise Device (ARED) during spaceflight.</p> <p><u>CMS PFE Operations (for all USOS crew):</u> This lesson covers the Periodic Fitness Evaluation procedure that is performed every 30 days in orbit.</p>			
	Schedule:	<p>BD2 Familiarity Session (for USOS crew): This highly desired lesson would include nominal BD2 operations (introductory session) and be limited to use of the hardware in the event of a contingency (needs RS and ITI agreement)</p> <p><u>CMS T2 Operations (for all USOS crew):</u> This lesson introduces the student to the purpose, components, and operations pertaining to the T2.</p> <p><u>CMS OPS SKILLS 1 (for all crew):</u> This lesson includes a student skill evaluation using the CMS hardware including the CEVIS, ARED, T2, HRM, and the Crew Health Care Systems (CHeCS) software.</p> <p><u>CMS OPS SKILLS 2 (for US crew only):</u> This lesson includes a student skill evaluation focusing on independently operating the ARED per checklist and procedure, and reviewing data transfer communication through electronic spreadsheets and Specialists will additionally be asked to demonstrate ARED Cylinder Evacuation.</p>			
		Duration:	Schedule:	Flexibility:	Personnel Required:
		CMS ARED OPS: 2.00 hr	L-1.5 year	+/- 1 month	Instructors/Crew
		CMS CEVIS OPS: 1.50 hr	L-16 months	+/- 1 month	Instructors/Crew
		ARED PT: 1.00 hr	16 total - L-1.5 yrs to launch	N/A	ASCR/Crew
		CMS PFE OPS: 1.50 hr	L-14 months	+/- 1 month	Instructors/Crew
		CMS T2 OPS: 1.25 hr	L-14 months	+/- 1 month	Instructors/Crew
		CMS OPS SKILLS 1: 1.00 hr	L-3 months	+/- 1 month	Instructors/Crew
		CMS OPS SKILLS 2: 1.00 hr	L-2 months	+/- 1 month	Instructors/Crew
Ground Support Requirements Hardware/Software		Preflight Hardware:	Preflight Software:		Test Location:
		Flight Training CEVIS Flight Training T2 Flight Training ARED Station Support Computer (SSC) Flight Training BD2	CEVIS Logging Software T2 Logging Software ARED Logging Software		U.S and RS for BD2 (BD2 is highly desired).
Training Facilities		Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
		Approximately 40 ft. x 20 ft.	Four 110 V AC (USA)	20 -25°C	N/A
		Hot or Cold Running Water:	Privacy Requirements:	Other:	
		N/A	N/A	N/A	

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Constraints/Special Requirements:	N/A
Launch Delay Requirements:	N/A
Notes:	N/A

Preflight Activities:

TABLE 3.4: PREFLIGHT ACTIVITIES

Preflight Activity	Description:			
	<u>Exercise Prescription</u>			
	Exercise sessions using high fidelity training equipment identical to that presently on ISS will be scheduled for training and familiarization beginning at L-18 months. During these sessions, the Astronaut Strength, Conditioning and Rehabilitation (ASCR) team will familiarize the crew with use of the exercise equipment, associated software, and their individual exercise prescriptions. Scheduling for 16 ARED training sessions will follow the agreed upon template in the MA-ITP CMO and MED OPS training flows.			
Schedule:	Duration:	Schedule:	Flexibility:	Personnel Required:
	1 hr	Start at L-18 and follow MA-ITP CMO and MED OPS training flows template	N/A	Crewmember/ASCR
Ground Support Requirements Hardware/Software	Preflight Hardware:		Preflight Software:	Test Location:
	Flight Training ARED		ARED Logging Software	U.S.
Testing Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
	Approximately 15 ft. x 15ft	Three 110 V AC (USA)	20 -25° C	N/A
	Hot or Cold Running Water:	Privacy Requirements:	Vibration/Acoustic Isolation:	Other:
	N/A	N/A	N/A	N/A
Constraints/Special Requirements:	N/A			
Launch Delay Requirements:	N/A			
Notes:	Takes place during normally scheduled gym time			
Data Delivery:	The ASCR team will provide progress reports to the crew surgeon on a periodic basis preflight.			

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3.5 In-Flight Activities

TABLE 3.5.1: In-Flight Activities

In-Flight Activity	Description:	Daily Aerobic and Strength Exercise 2.5 hours of daily physical exercise scheduled for each crewmember in-flight. The session will include time for set-up and takedown of hardware and post-exercise session hygiene. Aerobic exercise will consist of active or passive T2 and/or CEVIS, while strength conditioning will occur on a resistance exercise device (ARED). In-flight results will be transferred into the individual exercise data management program on the SSC or SSC File Server. BD2 could be used in the event of a contingency event (where T2 fails) and with RS agreement. Nominal BD2 data output would be expected in that event.				
	Schedule:	Activity:	Duration:	Schedule:	Flexibility:	Personnel Required:
		In-Flight Exercise Aerobic Resistance	2.5 hrs Total 1 hr 1.5 hrs	Daily	N/A	Crewmember
		Exercise File Download	00:05 on 6 separate days in a week for 1 CM to download all CMs data (included in 2.5 hrs.) Or Per Crewmember preference as long as data is downloaded weekly	Weekly	N/A	Crewmember
Procedures:		As prescribed				
Constraints / Special Requirements:		<ul style="list-style-type: none">• To begin no sooner than 00:90 after meal (In some cases, begin no sooner than 00:60 after breakfast and 00:75 after the midday meal.)• Complete no later than 2 hours before the start of sleep.• Can break up into two sessions of 1 hour and 1.5 hours per CM.• Arriving crewmember should be scheduled for nominal in-flight exercise as soon as possible but no later than the 5th day after arrival.• All crews must have received CMS Hardware familiarization on T2, ARED and CEVIS prior to their first exercise session.• Complete required ARED training sessions as agreed upon in the template in the MA-ITP CMO and MED OPS training flows.• Deviations from the above are possible on a case-by-case basis.• Exercise prescriptions are uplinked from the ground minimally once a week• Completed exercise prescription data is downlinked to the ground minimally once a week.				
Photo / TV Requirements:		<ul style="list-style-type: none">• In-flight exercise video of all crewmembers on all exercise hardware is required to monitor crew health, exercise effectiveness and crew safety.• Waived Exercise P/TV sessions should be agreed upon by Crew Surgeon, ASCR, and Crewmember. Waived Exercise P/TV sessions should be coordinated with Engineering due to shared video use.• Resistance exercise video is required within the first 14 days; but no earlier than the 3rd scheduled session and every 30 days thereafter for the duration of the increment. ARED real-time audio sessions will be scheduled for each crewmember up to 3 times per increment (and as clinically indicated) in conjunction with the nominal video session. Ergometry exercise video is required once during the increment. Video of the first PFE will meet this requirement.• Treadmill exercise video is required twice during the increment; within the first 30 days and between 60-90 days.				
Cold Stowage Requirements:		N/A				

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Mission Extension Requirements:	On-orbit strength and conditioning monitoring requirements will continue if the mission is extended.
Landing Wave-Off Requirements:	N/A
Data Delivery	Exercise data, including CEVIS data, is downloaded minimally once a week and transferred to the Mission Extended Medical Enterprise (MEME) FTP server. Heart Rate data may also need to be downloaded standalone and transferred to the MEME FTP server. ARED spreadsheets are transferred to the MEME Countermeasures SharePoint folder. T2 data is transferred to the CMS Ground Software Database. Biweekly interim reports and a final report regarding the exercise activities and prescribed exercise activities conducted during flight shall be compiled and completed by ASCR/ExPC personnel. The biweekly reports will be available in the Mission Medical Information System (MMIS) and delivered to the crew surgeon within 14 working days of data receipt. The final report will be available in MMIS and delivered to the crew surgeon within 45 days of mission end.

3.6 Postflight Activities: No Postflight Activities

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3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training					
CMS ARED OPS	2.00 hr	L-1.5 year	+/- 1 month	Instructors/Crew	None
CMS CEVIS OPS	1.50 hr	L-16 months	+/- 1 month	Instructors/Crew	
ARED PT	1.00 hr	16 total - L-1.5 yrs to launch	N/A	ASCR/Crew	
CMS PFE OPS	1.50 hr	L-14 months	+/- 1 month	Instructors/Crew	
CMS T2 OPS	1.25 hr	L-14 months	+/- 1 month	Instructors/Crew	
CMS OPS SKILLS 1	1.00 hr	L-3 months	+/- 1 month	Instructors/Crew	
CMS OPS SKILLS 2	1 hr	L-2 months	+/- 1 month	Instructors/Crew	
In-Flight					
In-flight exercise Aerobic Resistance	2.5 hrs 1 hr 1.5 hrs	Daily	N/A	Crewmember	<ul style="list-style-type: none">Arriving crewmember should be scheduled for nominal in-flight exercise as soon as possible but no later than the 5th day after arrival.To begin no sooner than 90 minutes after meal. (In some cases, begin no sooner than 00:60 after breakfast and 00:75 after the midday meal.)Complete no later than 2 hours before the start of sleep.Can break up into 2 sessions of 1 hour and 1.5 hours per crewmemberAll crews must have received CMS Hardware familiarization on T2, ARED and CEVIS prior to their first exercise session.Deviations from the above are possible on a case-by-case basis.

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Exercise File Download	00:05 on 6 separate days in a week for 1 CM to download all CMs data (included in 2.5 hrs.) Or Per Crewmember preference as long as data is downloaded weekly	Weekly	As reflected in duration	Crewmember	None